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CIRCULAR LETTER)
NO . . . . . 41)

SCHISTOSOMIASIS JAPONICA

1. GENERAL. Three species of blood flukes are important agents in the production of human disease: Schistosoma hematobium, S. mansoni, and S. japonicum. These parasites belong to the class of trematodes in the Phylum Platyhelminthes or flatworms. This circular is concerned with infections caused by S. japonicum, or schistosomiasis japonica, sometimes referred to as oriental schistosomiasis or as Katayama disease from the name of one of the Japanese areas in which it occurs.

2. GEOGRAPHIC DISTRIBUTION. Information on this subject is incomplete and it must be expected that schistosomiasis will be found in many places not mentioned below. In general, all operational areas in the vicinity of freshwater in Japan, Korea and China must be held suspect until competent medical investigation ascertains that schistosomiasis is absent.

a. General. The extent of schistosomiasis japonica is determined principally by the distribution of the species of snails which serve as intermediate hosts.

b. Japan. Five foci are known. These involve small areas, but in the past the rate of infection has been high. Four of these foci are on the main island of Honshu. The first is in the prefecture of Ibaraki, on the lower reaches of the Tone River, not far to the northeast of Tokyo, the second in the prefecture of Shizuoka, about Lake Ukishima, near Numadzu, the third in the prefecture of Yamanashi, in the rivers, ditches and rice paddies near Kofu, north of Mt. Fuji and the fourth in the prefectures of Okayama and Hiroshima, along the Ashida River in the Katayama district. The fifth focus is on Kyushu, the southern island, in the prefectures of Saga and Fukuoka, along the Chikugo River, near Kurume. In addition, reports of surveys show individuals passing schistosome eggs in the prefectures of Fukui, Tochigi, and Aomori, on the Island of Honshu. According to a recent unconfirmed report, schistosomiasis exists on the Island of Shikoku.

c. Korea. The disease has been reported from Korea; the foci of infection are not known.

d. Formosa. According to one report, a focus exists near Shinchiku, in the northwest part of the island. It is possible that schistosomiasis occurs elsewhere on the island.

e. China. Schistosomiasis is widely distributed in central and southern China, where large numbers of people are infected. It has not been found north of the tributaries of the Yangtze River. In all probability, the distribution of schistosomiasis in China is wider than is yet realized. Details are given in TB Med 167, June 1945, subject: "Schistosomiasis Japonica."

f. The Philippines. Schistosomiasis occurs on the Island of Leyte, and also on Samar, Mindoro, and in the region of Surigao in the northern part of Mindanao, near Valencia, Province of Bukidnon, and in the Province of Lanao, western Mindanao, from the Capasagan River Valley southward.

g. Celebes. A focus has been reported in the Lake Lindoe region in the central portion of the island.

3. ETIOLOGIC AGENT. a. Unlike other trematodes, the adult worms of Schistosoma have separate sexes. The female worms of S. japonicum are long and slender, measuring about 2.5 cm by 0.03 cm. The males are shorter and thicker; the sides of the posterior part of the body curl ventrally to form a groove in which the female worm is enclosed during most of her life.

b. Life Cycle. (1) The female worm, ordinarily residing in the smaller blood vessels of the mesentery, deposits eggs in the small venules of the intestinal wall. Some of these eggs gradually are extruded into the lumen of the gut and are discharged in the feces. Since the eggs are usually fully developed when passed, they hatch within a few hours upon dilution of the feces with fresh water, liberating a ciliated free-swimming larva known as a miracidium. Upon reaching a suitable snail which can serve as intermediate host, the miracidium invades the soft tissues of the mollusc where it undergoes development and asexual multiplication requiring several weeks. The ultimate result is the production of numerous free-swimming, fork-tailed cercariae, the infective stage for man.

(2) Cercariae emerge from infected snails over a period of several months. The cercariae are microscopic in size, their bodies measuring only about 0.15 mm in length. They tend to collect near the surface of the water. They are short-lived and must reach their final host within 1 or 2 days in order to continue their development. If cercariae are successful in contacting the skin or mucous membrance of man, or certain lower animals, they rapidly penetrate the tissue, and enter the venous circulation. After traversing the lungs and heart, the young worms that reach the intra-hepatic portions of the portal vein, mature and pair. They then proceed against the blood stream to small branches of the mesenteric veins where they settle down and where egg deposition occurs. Eggs first appear in the feces from 4 to 6 weeks following invasion of the body by cercariae. In the absence of effective treatment, adult worms may live and continue to deposit eggs for many years, perhaps 10 or 20 years.

(3) The young worms that do not succeed in reaching the portal circulation but settle in small vessels elsewhere are unable to complete their development and die.

4. TRANSMISSION. a. Only certain species of snails belonging to the genera Katayama, Oncomelania, and Schistosomophora are suitable for the larval development of Schistosoma japonicum. Sources of infection are limited to regions where these species are present. The snails are amphibious in their habits and because of their small size (3 to 10 mm in length) may easily be overlooked unless careful search is made of vegetation above the water line. Rapidly flowing water, however, cannot be regarded as necessarily safe, since cercariae may be washed into the stream from more favorable snail habitats located higher up. Inundated rice fields and ponds are dangerous sources of infection. Infested water may be quite clear.

b. Infection is generally acquired by wading, swimming, bathing, or otherwise coming in contact with water infested with cercariae. Contaminated drinking water is another but apparently less important source of infection. A few minutes of contact with heavily infested water are sufficient to produce a clinical infection.

c. Spread of schistosomiasis is favored by poor sanitation which allows contamination of water with feces containing eggs. Use of human excrement to fertilize rice fields is an important factor in the prevalence of schistosomiasis. However, animals other than man may also be involved in the spread of the disease. Dogs, cats, rats, field mice, swine, horses, cattle, and water buffalo may harbor Schistosoma japonicum and serve to disseminate the infection among snails.

5. COURSE. a. General. The lesions and symptoms of schistosomiasis japonica are due to the presence of the worms and their eggs, and probably also to substances given off by both worms and eggs. It is customary to divide the course of the disease into three stages but these stages are continuous, and, therefore, clinical phenomena attributed to the different stages may overlap. The first stage corresponds to the period from the penetration of the body by cercariae to the settling down of paired mature worms in the mesenteric venules. The second stage correspond to the period in which eggs are deposited by female worms in the small vessels of the intestinal wall. Many of these are extruded into the lumen of the gut and appear in the feces. Others are carried in numbers, which increase as time goes on, into the liver, mesenteric lymph nodes, and to a lesser degree other abdominal organs. In unusual cases, eggs may be found in the lungs, heart, brain, or other parts of the body, including the skin. Vastly more eggs, however, are always found in the intestinal wall and liver than elsewhere. The presence of eggs in the tissues gives rise to small abscess-like formations, which, in the case of the intestine, often rupture and release their contents into the gut. In practice, the symptoms associated with the first stage may be inseparable from those of the second stage. The

symptomatology of these stages, therefore, is described under one heading (b below). The third stage, which is associated with proliferation and repair of damaged tissues, is described in c below.

b. Early symptoms and signs. (1) It should be remembered that the symptoms are not necessarily a measure of severity of the infection. Early symptoms are often transient and may be overlooked. In some cases, a papular rash or itching, or both, may appear immediately after exposure. However, the first symptoms usually are noted between 3 and 10 weeks after infection, commonly after 5 to 6 weeks. In a carefully studied series of cases, the early symptoms included fever, headache, anorexia, unproductive cough, chills, general abdominal discomfort or crampy pains, urticaria, diarrhea and backache in the order named. Urticaria and diarrhea are not frequent symptoms. A clinical picture not unlike that of subacute appendicitis develops occasionally. Stiffness of the neck is a not infrequent symptom and is apparently of muscular origin.

(2) Physical examination reveals a slightly to moderately enlarged liver which is nearly always tender to palpation or heavy percussion. The spleen is felt at this stage in about one fourth of the cases. The lungs are usually clear although in rare cases coarse rales or rhonchi can be heard. X-ray examination of the lungs occasionally demonstrates scattered small areas of infiltration. On proctoscopic examination characteristic pseudo-tubercles can be seen in the wall of the rectum or lower signoid in about 2/3 of proven cases. Biopsy of these nodules, which is not to be a routine procedure, yields groups of ova. In appearance they are similar to the nodules seen in the bladder wall in cases of Schistosoma haematobium.

(3) Neurological findings. A few patients show an unusual pattern of central nervous system involvement. These patients may exhibit sensorial changes which vary from slight confusion to coma. Weakness and paresis of the extremities, particularly of the arms may occur. The deep reflexes may be exaggerated and ankle clonus may be present. Babinski and Hoffman reflexes are frequently evident. Ataxia is unusual. Sensory perception is ordinarily intact. The spinal fluid is normal.

(4) Course.

(a) The temperature is usually low in the morning and rises in the afternoon reaching from 101° to 105°, depending on the severity of the toxemia. The fever usually falls by lysis early in the second week of therapy. The pulse rate accompanies the fever. Anorexia is a prominent symptom and weight loss is often 10 to 20 pounds in army personnel.

(b) The acute symptoms often subside after two or more weeks, even without therapy. Fever disappears, appetite and strength return and the patient begins to regain the weight lost. The disease may be relatively latent thereafter.

(c) Occasionally the intensity of the acute phase leads to a fatal outcome. This is more apt to occur in cases with involvement of the central nervous system.

b. Late sequelae. As time goes on, affected tissues react to the increasing numbers of eggs deposited in them by extensive proliferation and repair. The results which may develop after a number of years include thickening of the intestinal wall and formation of papillomata, thrombosis of mesenteric, portal, or splenic veins, hepatomegaly, cirrhosis of the liver, splenomegaly, and ascites.

6. DIAGNOSIS. a. Clinical. In the early stage, a history of exposure is a most important clue to the diagnosis. Particularly significant is membership in a group of individuals with the same exposure and a similar clinical course. The findings of outstanding significance are itching immediately after exposure, followed some weeks later by fever, cough and tenderness over the liver which is usually palpable. Urticaria and diarrhea are confirmatory findings when present. Prominent findings in more advanced, untreated cases are a progressive enlargement of the liver and sometimes a palpable spleen. The diagnosis should be confirmed by the demonstration of ova in the stools. If necessary, proctoscopy may be used as an aid in diagnosis, provided personnel trained in the use of the instrument are available. It may be possible to see beneath the normal appearing mucosa clusters of small yellowish nodules. Specimens containing ova may sometimes thus be obtained when ova cannot be demonstrated in the stools.

b. Laboratory. (1) General. The fact that in early schistosomiasis characteristic symptoms may be entirely lacking has already been emphasized. A helpful diagnostic aid in a suspected case is examination of the blood. During the acute stages of schistosomiasis leukocytosis ranging from 12,000 to 20,000 with a high percentage of eosinophils is a common finding. Counts of 60,000 or more with 80% eosinophils are recorded. So important are these changes in the blood that the presence of leukocytosis with eosinophilia should suggest the diagnosis of schistosomiasis in a patient with unexplained fever who has resided in an area in which the disease is endemic. Other common causes of eosinophilia, the most important of which are hookworm and strongyloide, trichinosis, chronic allergic and dermatological conditions, should be excluded by appropriate examinations. The diagnosis of schistosomiasis is justified only when eggs are found in stool specimens or miracidia are identified after stool specimens have been subjected to conditions favorable to the hatching of eggs.

(2) Eggs. Considerable skill is necessary for the accurate identification of eggs. Immature and degenerate eggs cause much difficulty and are readily confused with normal stool constituents. It is not uncommon to observe in stools objects such as plant cells, having the morphological appearance of schistosome eggs. Important errors in diagnosis may thus result. Students of the disease should avail themselves of every opportunity to become skilled in the recognition of stool forms of the parasite which alone permit specific diagnosis of the disease. The stools of infected dogs in endemic areas are fertile sources of eggs in all stages of development and deterioration. Mature eggs containing fully developed, motile miracidia should cause no difficulty. These eggs are usually somewhat oblong, measuring 70 to 100 microns in length and 55 to 65 microns in width. A hook-like process, emerging from a slight depression on one side of the egg, is frequently but not always visible. In searching for eggs, the observer must be constantly alert to the fact that their detailed structure may be obscured by the adherence to them of tissue remnants and fecal debris.

(3) Stool Examination. Particularly in the early and late stages of the disease, eggs are difficult to demonstrate. Hence several techniques should be employed and repeatedly negative examinations required before the diagnosis is excluded.

(a) Examination of a direct smear. A simple saline suspension of feces on a microscopic slide may suffice for rapid positive diagnosis. If fecal masses contain streaks of blood or mucus, samples for examination should be taken from such areas. Negative results from direct smears in suspected cases are an indication for employing more efficient techniques. Flotation methods of concentration, such as the zinc sulphate method, lead to distortion of eggs and should not be employed.

(b) Sedimentation. A small portion of stool thoroughly mixed with 5 to 10 parts of tap water is poured through four layers of surgical gauze into a conical glass and allowed to settle for 45 minutes. Decanting of the supernatant fluid, resuspension and sedimentation are repeated several times until the supernatant fluid is relatively clear. The sediment is then transferred to a slide and microscopically examined. The entire process of sedimentation should not extend beyond 6 hours as egg hatching may occur.

(c) Glycerine Sedimentation Technique. This technique is considered the most dependable, practical method for concentrating eggs. Approximately 5 gm of stool are thoroughly mixed with 125 cc. of 0.5% glycerinated water. The suspension is filtered through four layers of gauze into a conical glass and allowed to settle for one hour. After decanting the supernatant fluid, an additional 125 cc of glycerinated water is added, thoroughly mixed and allowed to settle for 30 minutes. This process is repeated a third time and the supernatant fluid decanted. After mixing the sediment thoroughly, amounts of approximately 0.1 cc each are examined microscopically. The eggs found in roughly 0.3 cc represent from 25 to 50% of the eggs contained in 5 gm of feces.

(d) Egg-hatching Technique. The stool is permitted to stand for 6 hours at room temperature after passage. The above sedimentation technique is then carried out with a slightly larger portion of stool. The sediment is transferred to a narrow-mouthed bottle, preferably an Erlenmeyer flask, provided with a perforated rubber cork into which is inserted a piece of glass tubing 10 cm. long and 6 mm. inside diameter; the tubing should not extend below the bottom of the cork. The flask and the glass tube are filled with unchlorinated water, pH 7.6 so that the water rises to a level 3 cm. below the top of the glass tube. The flask is allowed to stand overnight. On hatching, the miracidia rise to the upper layer of the water in the tube where they may be readily seen by means of a hand lens as actively swimming white boat-shaped objects.

(e) Acid-ether Technique. This is not recommended.

7. TREATMENT. a. General. The treatment of late schistosomiasis with established hepatic disease is not discussed here. All patients should be hospitalized during chemotherapy. In early schistosomiasis, if significant constitutional symptoms or diarrhea are present, the patient should be confined to bed. The diet should afford a liberal supply of all the essential nutrients. Supplementation with four multivitamin tablets a day is recommended. If diarrhea is present, the diet should be bland or soft.

b. Chemotherapy. (1) Drug treatment should be instituted at the earlist possible time. Compounds of trivalent antimony are the most effective known agents. Pentavalent antimony preparations, such as neostibosan, are relatively ineffectual. At present, it is recommended that patients with schistosomiasis be treated with fuadin or with antimony and potassium tartrate. The courses recommended below are planned to provide approximately equal amounts of antimony, in order to permit comparison of the two drugs on this basis. Authority for the trial use of other chemotherapeutic agents should be obtained from the Chief Surgeon, AFPAC.

(2) All available preparations of antimony possess toxic properties which are potentially dangerous. Nevertheless, the early institution of chemotherapy for schistosomiasis is imperative, unless the presence of another serious disease contraindicates it. Antimony compounds should always be given with care, especially with close observation of the patient's reactions to their administration. It should be remembered that small dosages are often followed by therapeutic failure. Among the toxic effects which have been reported are depression of the circulation and respiration, together with indications of irritation of the central nervous system, liver, and kidneys. Sudden death during injection has been reported. In general, antimony compounds are contraindicated in the presence of disease of the heart, liver, or kidneys. As a rule, they should not be administered concurrently with other metals or potential cardiac depressants, such as emetine.

(3) Chiefs of medical services are urged to observe carefully the relative value of the drugs hereinafter described. These data should be communicated to this headquarters in order that accurate information eventually may be accumulated.

c. Antimony and potassium tartrate (tartar emetic).

(1) This preparation contains about 36 percent antimony (Medical Supply Catalogue No. 1071000). It is recommended that it be administered in a concentration of 0.5 percent. Solutions should be freshly prepared, using if available Medical Department supplies of sterile 5 percent glucose in physiological saline solution, sodium chloride isotonic solution, or distilled water (preference in that order), rather than locally prepared diluents. If the diluent is prepared locally, it should be freshly distilled and sterilized. Solutions of antimony and potassium tartrate should be perfectly clear and free of sediment. If a freshly opened clean supply of drug is available, with aseptic precautions it may be removed from the container, weighed, and transferred to sterile diluent, using sterile spatula and weighing vessels. With a fresh, clean supply of drug, sterile diluent, and careful technique, such a solution may be administered intravenously without sterilization. If doubt exists regarding the suitability of available supplies or technique, antimony or potassium tartrate solutions should be sterilized by gentle boiling for 5 minutes. They should not be autoclaved.

(2) Antimony and potassium tartrate is best tolerated 2 or 3 hours after a light meal. It should be administered intravenously and should be given slowly. Since the solution is very irritating to the tissues and may cause sloughing, the needle should be wiped off with a sterile sponge and there should be no extravasation. The patient should remain recumbent for at least an hour after treatment. The first dose of the 0.5 percent solution is 8 cc (0.04 gm tartrate). Provided no untoward reaction occurs, subsequent doses are given on alternate days and are increased on each occasion by 4 cc (0.02 gm tartrate), until 28 cc (1.14 gm tartrate) are given. If no toxic reaction appears, a total of 15 doses is given (360 cc of solution, containing 1.8 gm tartrate or 0.648 gm antimony). The toxic effects of antimony and potassium tartrate include coughing immediately upon injection, which is not important; nausea; vomiting; stiffness of joints and muscles; sense of constriction of the chest; pain in the upper abdomen; bradycardia; dizziness; and collapse. Transient electrocardiographic changes without corresponding clinical manifestations have been reported. If a toxic reaction other than coughing occurs during administration, the injection should be stopped at once. Following any toxic effect, the subsequent dose should be reduced or the administration of the drug temporarily or permanently discontinued, according to the circumstances. The course of treatment should not be repeated until after 2 weeks have elapsed without treatment.

d. Fuadin. This drug is also known as necantimosan and stibophan. The solid contains 13.6 percent antimony. It is supplied in ampules containing 6.4 percent solution (approximately 0.064 gm fuadin in 1 cc). (Medical Supply Catalogue No. 1208000). Fuadin solution is given intramuscularly and should be injected slowly. The first three doses of 1.5 cc, 3.5 cc, and 5.0 cc are given on successive days. On the fifth and subsequent alternate days, 5 cc are given, provided no toxic effect other than nausea appears, until a total of 16 doses has been administered (75 cc of solution, containing 0.653 gm of antimony). The only commonly reported toxic symptoms are nausea and vomiting. Rarely, joint and muscle pains may appear. If toxic symptoms occur, the subsequent dose should be reduced or the administration temporarily or permanently discontinued, according to the circumstances. The results of treatment should be checked as described in paragraph 8. The course of treatment may be repeated after 2 weeks' rest. However, if a course of fuadin is ineffectual, it is recommended that the patient receive antimony and potassium tartrate.

8. DISPOSITION AND ITS RELATION TO TREATMENT. It is desired that patients in whom the diagnosis of schistosomiasis is firmly established shall be given one course of treatment and then be evacuated to the Zone of the Interior as soon as their condition permits. Subsequent observations ordinarily will be made and treatment given in the United States. However, observation and therapy should be continued when evacuation is delayed as by

lack of transportation. It is of particular importance in these cases that full clinical records, including the laboratory findings and the treatment given, should accompany the patient when evacuated. Such records will insure the patient's being designated for transfer to one of the special centers for tropical disease in the United States.

9. FOLLOW-UP. In many cases, it is necessary to give more than one course of treatment. Hence, it is essential that the results of treatment for schistosomiasis be carefully checked. As chemotherapy becomes effective, eggs which are passed cease to contain viable miracidia. They appear dark, shriveled, and do not hatch when placed in water (See par. 6d). During treatment eggs usually ceased to appear. This does not mean necessarily that treatment has been successful from the standpoint of killing or expelling worms since in some cases egg production may be resumed later. Stool examination should be done at the end of a course of treatment, and at weekly intervals thereafter for at least 3 months. Individuals who have had schistosomiasis should be reexamined from time to time for a year following treatment. If eggs with living embryos are found, treatment should be reinstituted after a suitable interval has elapsed following the previous treatment.

10. PROGNOSIS AND PSYCHOLOGICAL IMPLICATIONS. a. The amount and frequency of repetition of infection are important elements in determining the prognosis. The proportion of patients with Schistosomiasis japonica who, even without treatment, acquire the late lesions of the disease is unknown.

b. The prompt administration of treatment has been found to relieve the early symptoms, including at least in some instances even severe manifestations of central nervous system involvement. It is believed that chemotherapy when instituted early is effective in preventing the development of severe sequelae. If cirrhosis of the liver and fibrotic lesions of other organs are well established, chemotherapy does not influence the course.

c. Medical officers should bear in mind the psychological hazards of this disease particularly when answering the patient's questions about his disorder or when briefing the patient for evacuation and further treatment at another installation. It is often difficult to avoid telling the patient more than he can understand, to avoid outlining the diagnostic or therapeutic procedures that "should be followed" by the next medical installation and to avoid statements which cause the patient to doubt his eventual recovery.

11. PREVENTION. a. General: Prevention of schistosomiasis in military forces depends primarily upon avoidance of contact with fresh water infested with cercariae. Protective measures should be planned in advance when entering known endemic areas. Surveys should be made as early as feasible in all areas of suspected or possible endemicity.

b. Surveys. Information about the presence of schistosomiasis in a suspected locality is obtained by determining the number of egg passers in the native population, by searching for snails infected with cercariae of Schistosoma japonicum, by examining the local dog and rat population for post mortem evidence of schistosomiasis infection and by computing the liver index in native children under 15 years of age. A rapid survey may be made by examining the stools of those natives who have enlarged livers. These procedures require exact technique by qualified personnel. The apparent absence of snails does not guarantee freedom from cerceriae.

c. Avoidance of exposure. (1) Swimming, bathing, and laundering of clothes, and the washing of vehicles in fresh water ponds, streams, and canals should be prohibited in all known or suspected endemic areas and appropriate warning signs should be posted. Educational lectures and propaganda posters should be freely utilized to indoctrinate troops in the necessity for avoiding contact with infested water. Orders regarding avoidance of exposure should be strictly enforced by the imposition of fines or by other appropriate punishment.

(2) When practicable, rubber hip boots, waders, rubber gloves, or other waterproofed clothing should be worn by personnel whose duties require that they work in unsafe water. Care should be taken not to splash water on unprotected parts of the body. In the event that rubberized equipment is not available, closely woven cloth such as herringbone twill (HBT) or Zelanized sateen will give partial protection against entrance of the cercariae. The bottoms of trousers must be carefully tucked into the tops of combat boots in order to prevent direct contact of water with the skin of the lower extremities. This protection is increased by impregnation of the clothing with repellents as described in TB Med 121, December 1944 and in USAFFE Technical Memorandum No. 9, "Control of Scrub Typhus." Q.M. item number 51-R-300 is used to designate 3 different bulk repellents, benzyl benzoate, dibutyl phthalate and dimethyl phthalate, which are of value in the order named. New issues of these repellents will contain an emulsifier - no soap needed - and directions for use will be printed on the label. It is important to note that the hands and other skin surfaces in direct contact with water are not protected by the above mentioned measures. The application of repellents directly to unprotected skin prior to exposure is not of fully established value but should be used where exposure is unavoidable. Such repellents are more effective when incorporated to a strength of 20 percent in an ointment base.

(3) Shower bath water for small units required to remain away from their base should be provided from Lyster bags in which the water is treated as described in c (2) below. The Lyster bag can be hung at a suitable height from a branch or from a support stretched between two trees. Improvised showerheads should be prepared beforehand and connected to the faucets of the Lyster bag by a rubber hose. Use of such an expedient will minimize infractions of bathing discipline.

(4) In case of accidental entrance into water suspected of containing cercariae, immediate application of heavy soap lather or any of the insect repellents directly to the wet skin will reduce the chance of infection.

c. Treatment of Water. Only water treated so that cercariae are killed should be used for bathing, laundry, vehicle washing, and drinking purposes. Maximum use should be made of subsurface water as a source of supply. Usual methods of filtration and chlorination cannot be relied upon to remove or destroy cercariae. Recommendations for the treatment of water in areas where schistosomiasis is a hazard are summarized below.

(1) The standard portable or mobile sand filter purification units will not remove all cercariae; hence, sufficient chlorination to kill cercariae must also be employed. The newly standardized diatomaceous earth filter, however, is effective in filtering out cercariae.

(2) Application of chlorine sufficient to provide 1 part per million residual at the end of 30 minutes contact is sufficient to kill cercariae. It is important to note that this contact time exceeds that normally required for Lyster bag treatment. When employing Lyster bags, a satisfactory procedure which affords a margin of safety for the destruction of cercariae is to add sufficient calcium hypochlorite (grade A) to provide 1 part per million of residual chlorine after 10 minutes contact. An additional ampule of calcium hypochlorite should then be added and the water allowed to stand 30 minutes before use. When using canteens, treatment with two halazone tablets for clear water and four tablets for turbid or colored water is adequate to kill cercariae after 30 minutes contact.

(3) Water can be rendered free of infective cercariae by heating to 125° F. or by storage for 72 hours. In either case, the water should be chlorinated before use.

(4) Water for bathing and laundering. Wells and springs may be designated in the unit area for bathing and laundry provided each water source fulfills the following requirements.

(a) Freedom from any surface contamination.

(b) Treatment of the well or spring with chemicals as directed in par. 11 d.

(c) Posting of signs stating that water is only for bathing and laundry and is not safe for drinking.

d. Destruction of snail hosts. Copper carbonate dust at the rate of 12 pounds per 1,000 square feet of water surface may be used to kill the snail intermediate host. A mixture

composed of Paris green, 6 pounds and slaked lime, 24 pounds per 1,000 square feet of water surface is effective for the same purpose. A concentration of 10 parts per million of copper sulfate after 48 hours of contact destroys free-swimming cercariae. It is important, when treating wells or springs, to pulverize the copper sulphate and then to dissolve it in a small quantity of water before application to the water source. Because of the amphibious habits of the snail hosts of Schistosoma japonicum, chemical treatment of the water should be supplemented by the application of slaked lime to the ground and vegetation on the banks and along the shoreline of the water. Measures for killing snails have their greatest usefulness where the infested bodies of water are small. Their value is limited in places where extensive areas must be treated.

e. Disposal of feces. Prevention of pollution of water by proper disposal of human feces from infected individuals is a control measure which reduces the number of infected snails. However, domestic animals such as dogs, cats, swine, cattle, and water buffalo often harbor Schistosomiasis japonicum and may serve to spread the infection, as do wild rodents.

12. This circular letter is based upon WD TB Med. No. 167, June 1945 and upon the investigations of the Schistosomiasis Commission and other field and clinical studies carried out in this theater.

13. Recission. USAFFE Technical Memorandum No. 15, Office of the Theatre Surgeon, 21 October 1944, subject: Schistosomiasis and Paragoniniasis; USAFFE Technical Memorandum No. 5, Office of the Theatre Surgeon, 31 March 1945, subject: Diagnosis of Schistosomiasis; and Ltr. Hq. USAFFE, FTMD 710, 5 March 1945, subject: Aftercare of Patients with Schistosomiasis, are rescinded.

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